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Commerci et al.

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[54] **ELECTRICAL CONNECTOR TERMINAL ARRANGEMENT**

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[51] **Int. Cl.**[7] **H01R 25/00**

[52] **U.S. Cl.** **439/287**; 437/289

[58] **Field of Search** 439/287, 289, 439/862, 284

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,266,845	5/1981	Ishikawa	439/862
4,657,320	4/1987	Bamford et al.	339/4
5,183,409	2/1993	Clever et al.	439/291
5,199,884	4/1993	Kaufman et al.	439/74
5,520,545	5/1996	Sipe	439/65
5,575,674	11/1996	Davis et al.	439/284
5,727,961	3/1998	Landis et al.	439/287

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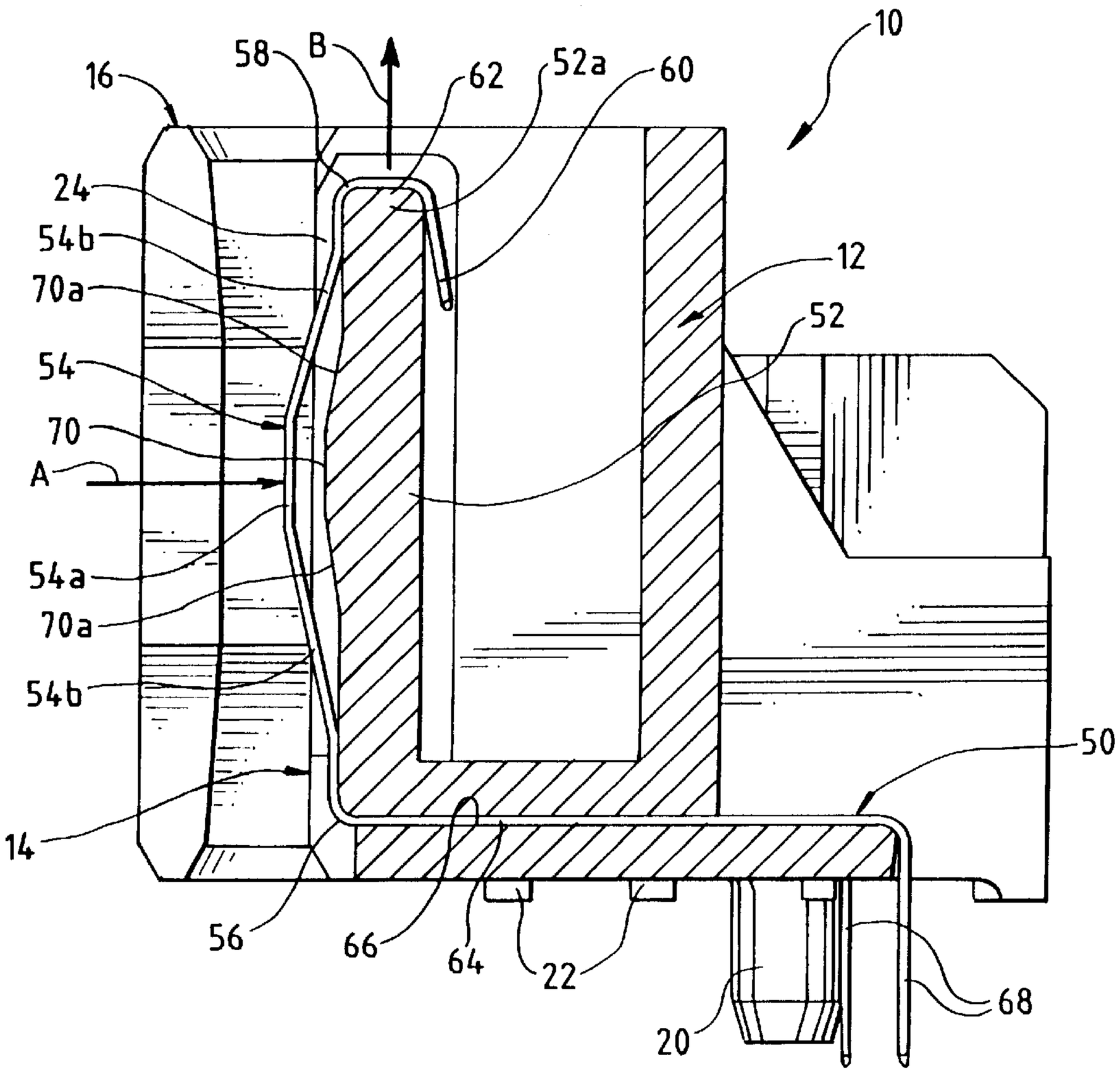
Assistant Examiner—Chandrika Prasad
Attorney, Agent, or Firm—Stephen Z. Weiss

[57] **ABSTRACT**

An electrical connector assembly includes a pair of hermaphroditic connectors having opposed mating faces which are juxtaposed generally along a plane when the connectors are mated. Each connector includes a housing having a wall at the mating face of the connector. The wall extends generally parallel to the mating face and includes opposite ends. At least one terminal is mounted on the housing and has a contact portion spaced outwardly of the wall for flexing toward and away from the wall generally perpendicular to the mating face. The contact portion has a first end anchored at one end of the wall and a second end engageable with the opposite end of the wall and slidable relative thereto generally parallel to the mating face.

15 Claims, 6 Drawing Sheets



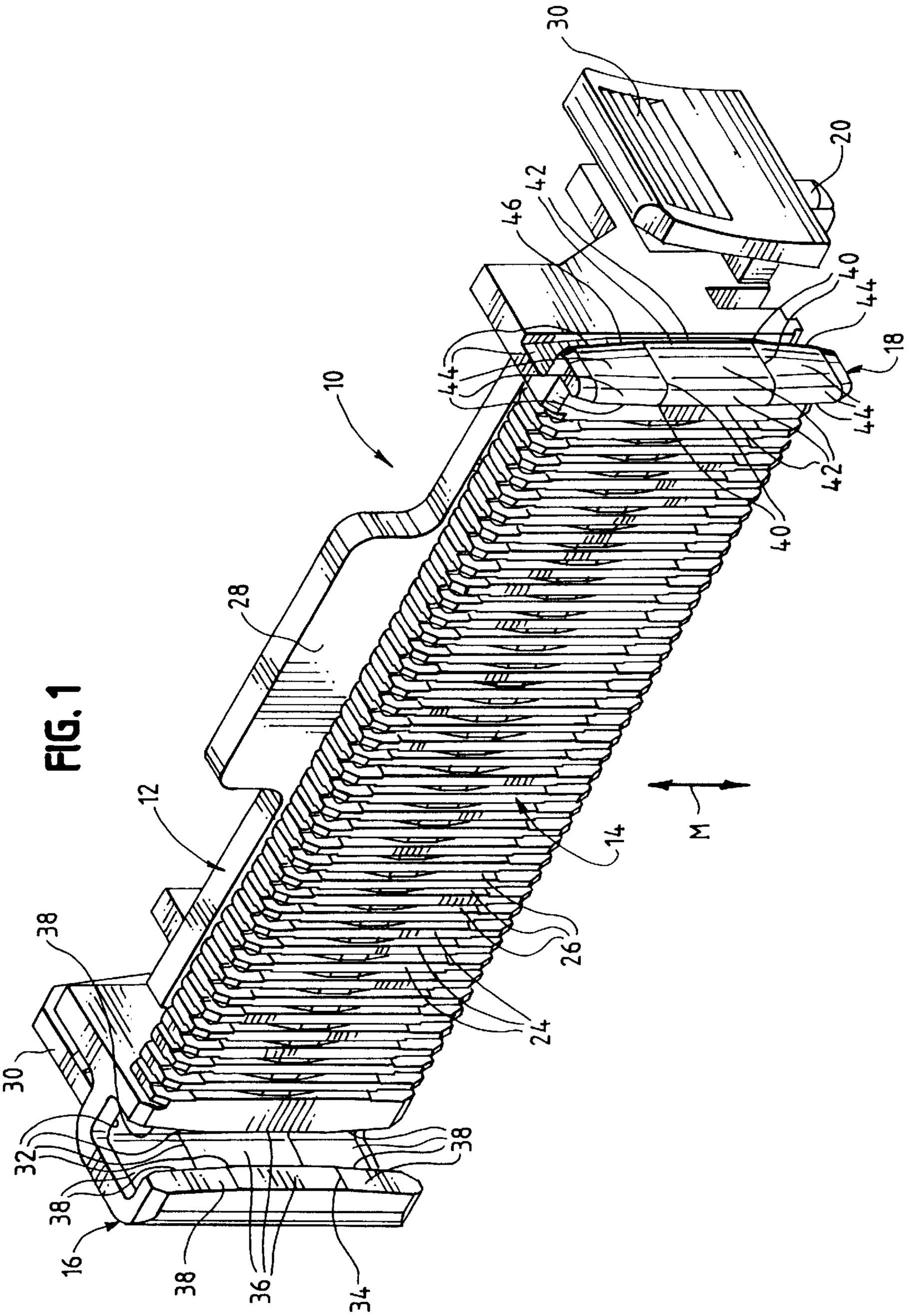


FIG. 1

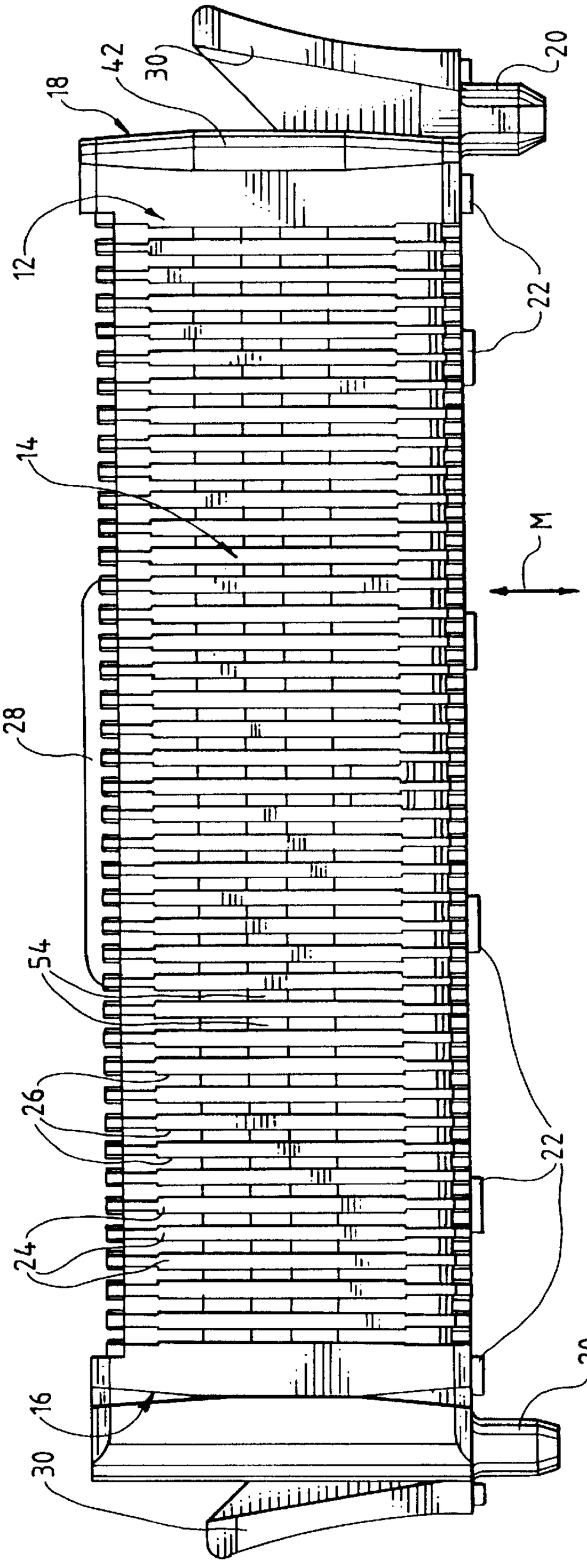


FIG. 2

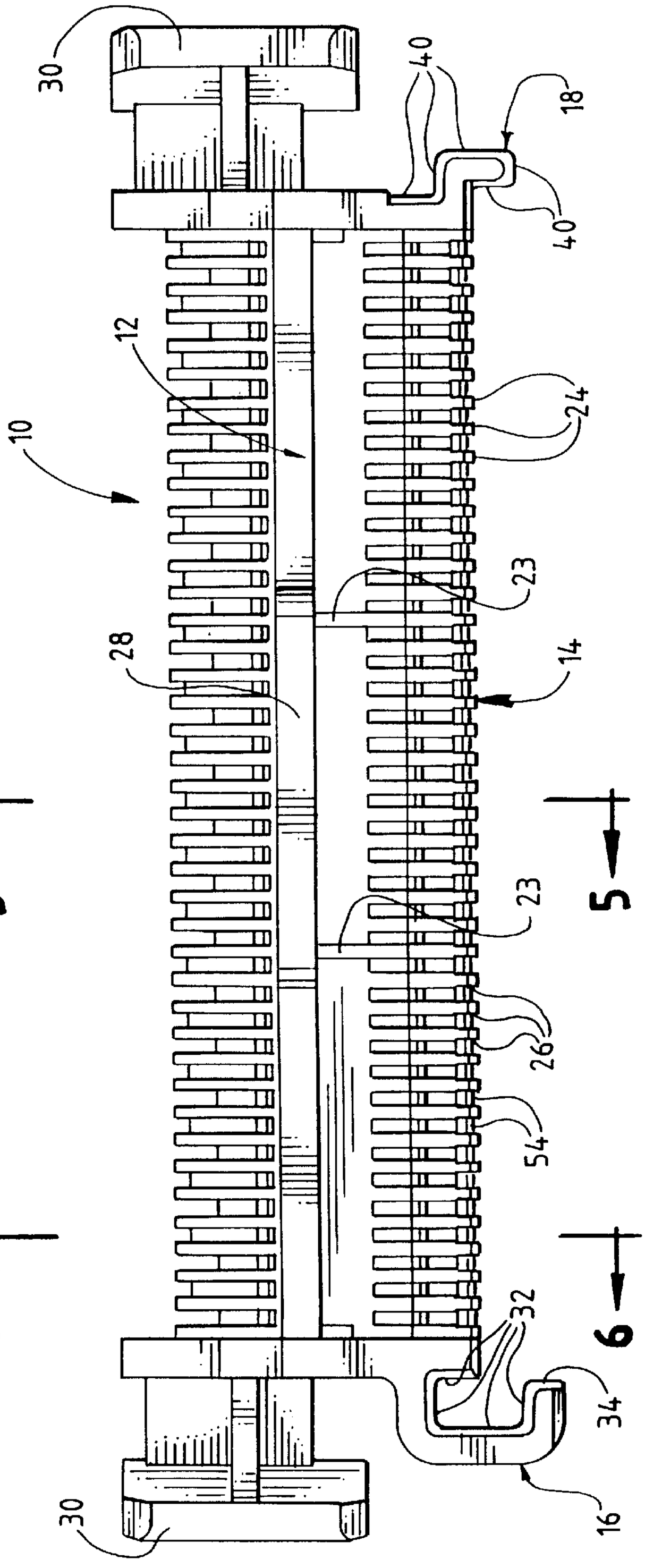


FIG. 3

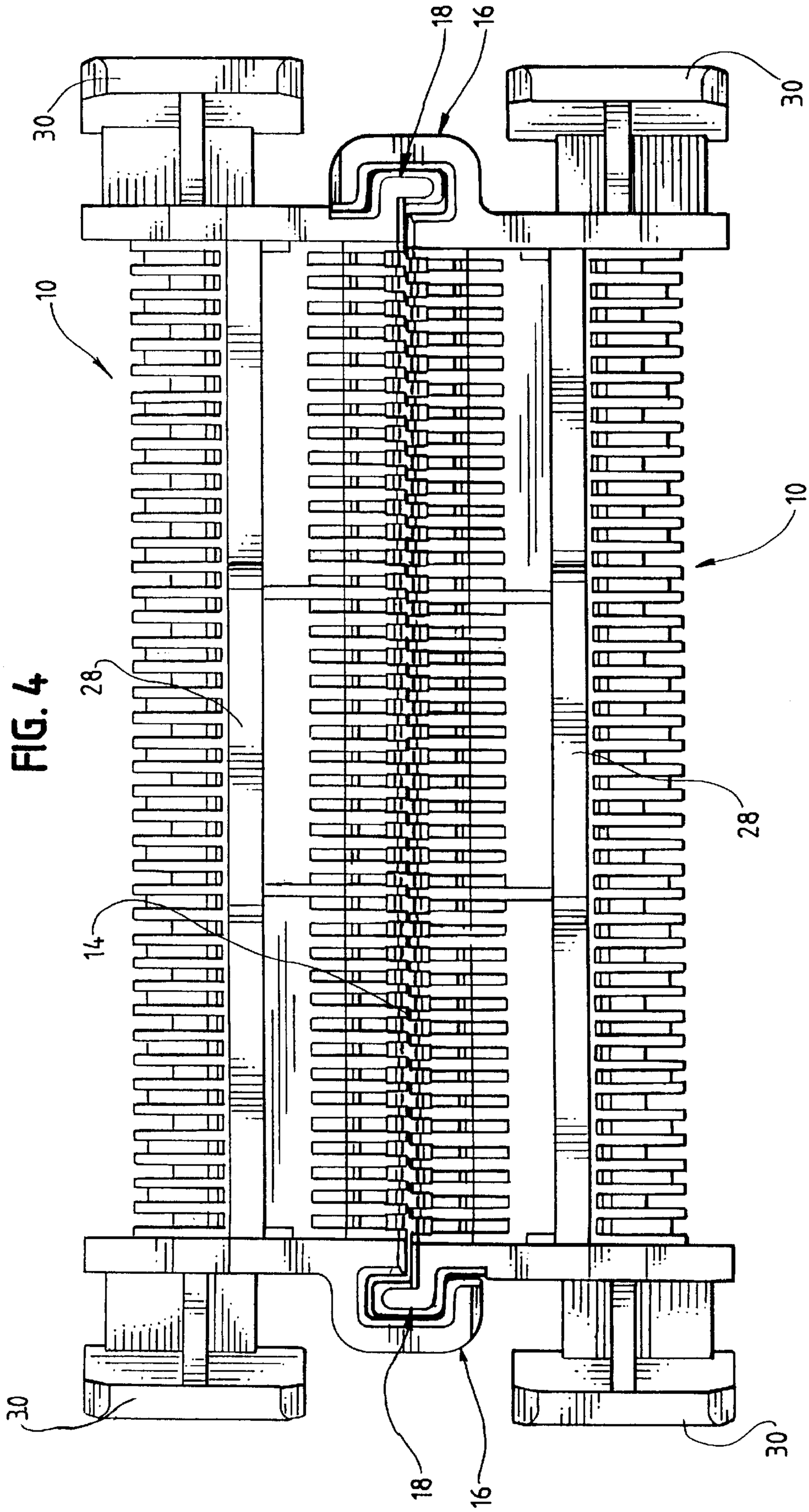


FIG. 4

FIG. 5

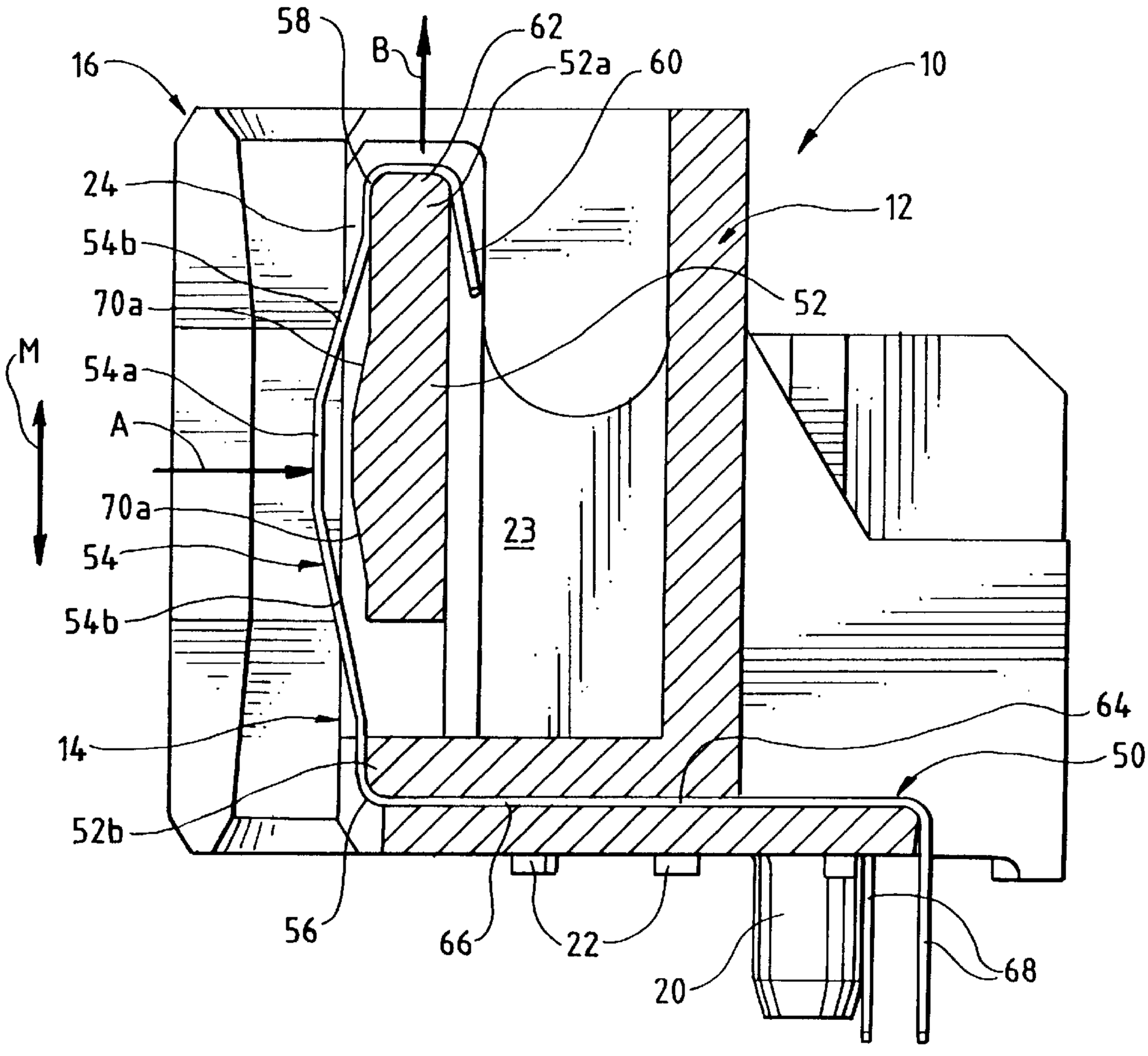
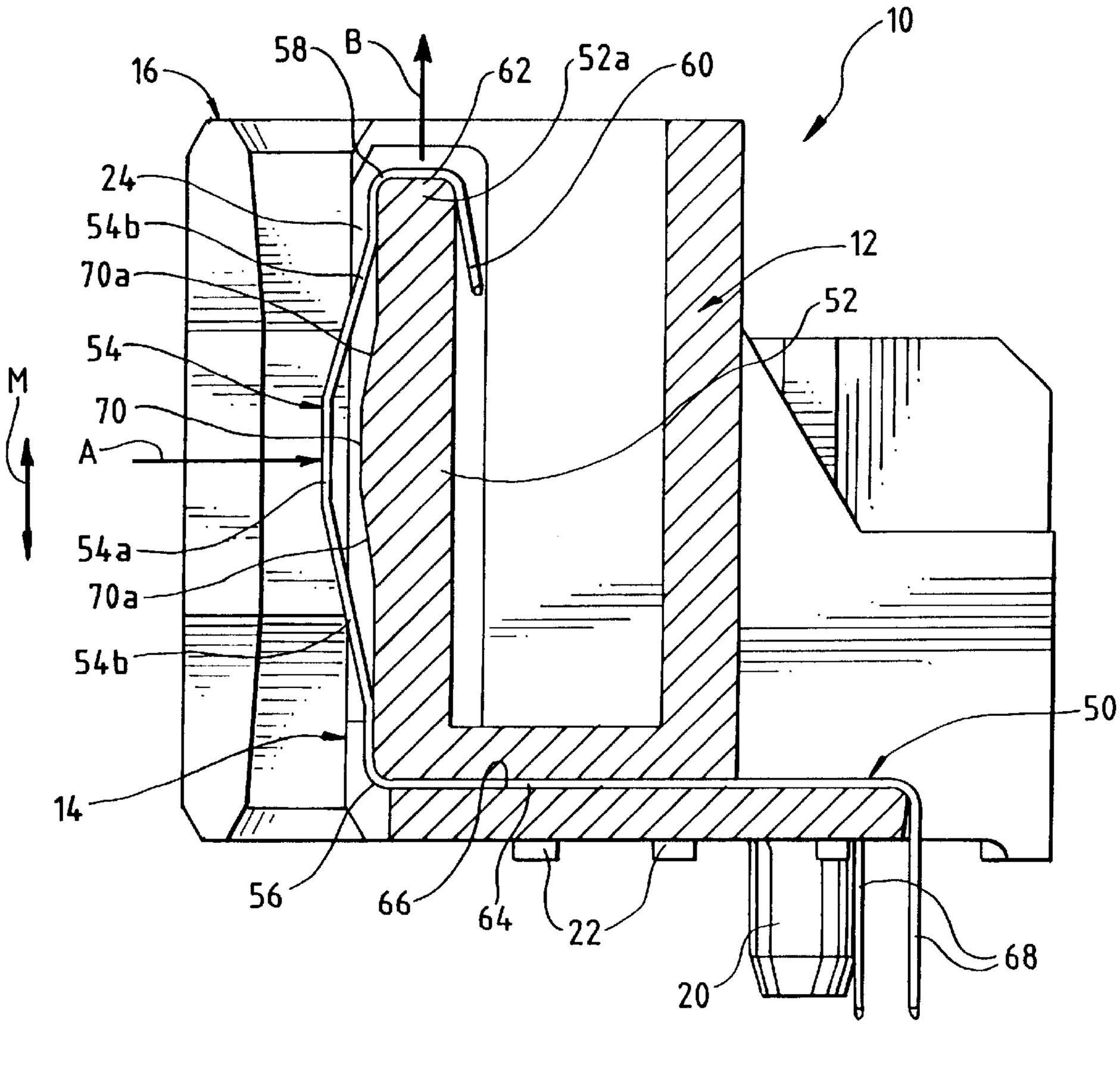

58
B
62
16
52a
60
10
24
12
54b
70a
52
M
54a
A
70a
23
54
54b
64
14
50
52b
56
66
22
20
68

FIG. 6


10
16
58
B
62
52a
60
24
54b
70a
54
70
A
M
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70a
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68

ELECTRICAL CONNECTOR TERMINAL ARRANGEMENT

FIELD OF THE INVENTION

This invention generally relates to the art of electrical connectors and, particularly, to a terminal arrangement in an electrical connector, such as in a hermaphroditic electrical connector.

BACKGROUND OF THE INVENTION

Generally, an electrical connector includes some form of dielectric or insulating housing which mounts one or more conductive electrical terminals. The terminals have contact portions which are adapted for engaging the contact portions of the terminals of a complementary mating electrical connector or other connecting device. In an electrical connector assembly, a pair of mating connectors are interconnected for establishing one or more electrical circuits through the assembly interface.

Electrical connectors are used in a wide variety of applications. They may interconnect discrete electrical wires or they may interconnect a plurality of printed circuit boards or they may interconnect discrete wires with circuit traces on a circuit board, for instance. Electrical connectors also are used in a wide variety of environments, such as through panels or backplanes as well as in "drawer" applications, for instance.

In many applications, interconnecting electrical connectors are complex and expensive, involving one type of connector (such as a male or plug connector) and still another type of connector (such as a female or receptacle connector). In some instances, a pair of hermaphroditic connectors are used in an electrical connector assembly to simplify the assembly and reduce its costs. One type of hermaphroditic connector system includes a pair of hermaphroditic connectors having opposed mating faces which are juxtaposed generally along a plane when the connectors are mated. The connectors are adapted for mating in directions generally parallel to the plane of the mating faces. There have been certain problems with these types of connectors, such as binding of the connectors when the housings are mated in a slightly skewed condition, particularly when the housings are elongated. Other problems involve the contact forces changing significantly when the opposing contacts engage at different positions at the mating faces between the connectors. The present invention is directed to solving these various problems and to providing simple, inexpensive and effective hermaphroditic electrical connectors.

SUMMARY OF THE INVENTION

An object, therefore, of the invention is to provide an electrical connector with a new and improved terminal system or arrangement.

Another object of the invention is to provide a new and improved electrical connector assembly including a pair of hermaphroditic connectors employing the terminal system.

In the exemplary embodiment of the invention, an electrical connector assembly includes a pair of hermaphroditic connectors having opposed mating faces which are juxtaposed generally along a plane when the connectors are mated. The connectors are adapted for mating in either opposite direction generally parallel to the plane of the mating faces.

Each hermaphroditic connector includes a housing having a wall at the mating face of the connector. The wall extends

in the mating direction and includes opposite ends. At least one terminal is mounted on the housing and has a contact portion spaced outwardly of the wall for flexing toward and away from the wall generally perpendicular to the mating direction. The contact portion has a first end anchored at one end of the wall and a second end engageable with the opposite end of the wall and slidable relative thereto in the mating direction.

As disclosed herein, the wall has an edge at the opposite end thereof. The second end of the contact portion of the terminal has a hook for embracing the edge of the wall. The contact portion of the terminal is bowed outwardly of the wall at a point intermediate the first and second ends of the contact portion. Preferably, a plurality of the terminals are spaced along the housing at the mating face of the connector.

A feature of the invention comprises a projection behind the outwardly bowed contact portion of the terminal intermediate the first and second ends thereof. The projection prevents overtravel of the contact portion in flexing toward the wall. Preferably, the wall is tapered on opposite sides of the projection.

The invention contemplates that the housing be fabricated of dielectric plastic material, and the housing may be overmolded about at least a portion of the terminal to anchor the first end of the contact portion at the one end of the wall.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIG. **1** is a perspective view looking at the mating face of a hermaphroditic connector with some terminals shown embodying the concepts of the invention;

FIG. **2** is a front elevational view of the connector;

FIG. **3** is a top plan view of the connector;

FIG. **4** is a top plan view of a pair of the connectors in mated condition;

FIG. **5** is a vertical section taken generally along line **5—5** of FIG. **3** with some terminals shown; and

FIG. **6** is a vertical section taken generally along line **6—6** of FIG. **3** with some terminals shown.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in greater detail, and first to FIGS. **1–3**, the invention is embodied in a hermaphroditic electrical connector, generally designated **10**. A pair of the hermaphroditic connectors are shown in mated condition in FIG. **4** and will be described hereinafter.

Referring first to FIGS. **1–3**, hermaphroditic connector **10** includes an elongated dielectric housing, generally designated **12**, defining a mating face, generally designated **14**, whereby the mating faces of a pair of the connectors are juxtaposed generally along a plane when the connectors are mated in the direction of double-headed arrow "M".

Generally, complementary interengaging latch means are provided on housing **12** of each connector **10** to lock a pair

of the connectors against unmating in a direction generally perpendicular to the plane of mating faces **14**. In particular, the complementary interengaging latch means are provided by a locking hook, generally designated **16**, at one end of the housing for embracing an engaging flange, generally designated **18**, at the opposite end of the housing of the mating connector. FIG. **2** shows a pair of mounting posts **20** depending from opposite ends of the housing for insertion into appropriate mounting holes in a printed circuit board (not shown). FIG. **2** also shows a plurality of standoffs **22** at the bottom of the housing for elevating the housing slightly above the surface of the printed circuit board. A pair of support ribs **23** extend transversely of the longitudinal direction of the housing.

Mating face **14** of each hermaphroditic connector **10** actually is defined by a plurality of longitudinally spaced ribs **24** defining a plurality of grooves **26** therebetween. A plurality of terminals are mounted in the housing and include contact portions disposed in the grooves between the ribs, as will be described in greater detail hereinafter.

In order to facilitate unmating of a pair of the hermaphroditic connectors **10**, an upwardly projecting pull tab **28** is provided intermediate opposite ends of housing **12**. This pull tab can be grasped by an operator with a pair of pliers. In addition, a pair of pull tabs **30** also are provided projecting from opposite ends of the housing, again for grasping between the thumb and forefinger of an operator.

Locking hook **16** and engaging flange **18** which define the complementary interengaging latch means between a pair of the hermaphroditic connectors **10** have opposing abutment surfaces that are elongated in the mating direction of the connectors and which are configured with inclined ramp portions to prevent the housings from binding when the connectors are mated in slightly skewed orientations. More particularly, locking hook **16** has two inner sides **32** and an edge **34** all with inclined ramp portions **38** and inner sides **33** each comprising one flat surface which define abutment surfaces that are elongated in the mating direction of the connector. Inner sides **32** and edge **34** have "non-binding" configurations. Each inner side **32** and edge **34** include a central, generally flat abutment portion **36** which is generally parallel to the mating direction of the connectors. Inclined ramp portions **38** are formed at opposite ends of each central abutment portion **36** in the mating direction of the connectors. These inclined ramps minimize binding of the housings of the connectors when attempts are made to mate the connectors in relatively skewed orientations.

Correspondingly, engaging flange **18** of each hermaphroditic connector has a generally rectangular cross-section defining two sides **40** and slot **46** all with inclined ramp portions **44** and two sides **41** each comprising one flat surface. The two sides **40**, two sides **41** and slot **46** of the engaging flange define an abutment surface that is elongated in the mating direction of the connectors and which oppose the four inner sides **32**, **33** and edge **34** of locking hook **16** of the mating connector. Sides **40** and slot **46** of engaging flange **18** include a generally flat, central abutment portion **42** in the mating direction of connectors. Edge **34** cooperates with slot **46**. With this configuration all of the central abutment portions **42** in sides **40** and slot **46** of engaging flange **18** are opposed to the central abutment portions **36** on the inner sides **32** and edge **34** of locking hook **16**. Correspondingly, inclined ramp portions **44** in sides **40** and slot **46** of engaging flange **18** oppose the inclined ramp portions **38** within locking hook **16**.

FIG. **4** shows two hermaphroditic connectors **10** in mated condition. It can be seen that engaging flange **18** of each hermaphroditic connector is embraced by the locking hook **16** of the other hermaphroditic connector in a pair of the connectors. The locking hooks and the engaging flanges form complementary interengaging latch means to lock the connectors against unmating in a direction generally perpendicular to the plane of mating faces **14** of the connectors.

FIGS. **5** and **6** show two of the plurality of terminals, generally designated **50**, which are mounted on housing **12** and which are spaced along the elongated housing. It can be seen that the housing includes a wall **52** running the length thereof and from which ribs **24** project at mating face **14** of the connector. The wall extends in the mating direction of the terminal and includes a top end **52***a* and a bottom end **52***b*. Each terminal **50** includes a contact portion, generally designated **54**, disposed within a groove between a pair of ribs **24**. The contact portion bows outwardly from housing wall **52** and mating face **14**. The contact portion has a flat contact section **54***a* and ramp sections **54***b* extending from the contact section back toward the housing wall.

The invention contemplates that contact portion **54** of each terminal **50** includes a first, fixed end **56** anchored to housing **12** at bottom end **52***b* of wall **52** and a second, free end **58** which is engageable with the top end **52***a* of wall **52** and slidable relative thereto in the mating direction of the connectors. Contact portion **54**, particularly contact section **54***a* thereof, can flex toward and away from wall **50** upon abutting engagement with the contact portion of a corresponding terminal of the mating hermaphroditic connector. In other words, when contact section **54***a* of contact portion **54** engages the contact section of the mating connector terminal, contact portion **54** flexes inwardly toward wall **52** in the direction of arrow "A". This causes the free end **58** of the contact portion to move upwardly in the direction of arrow "B". The result is that there is very little shifting of the contact position with the terminal system or arrangement of the invention.

Still referring to FIGS. **5** and **6**, free end **58** of contact portion **54** of each terminal **50** includes a hook **60** which is bent around a top edge **62** of housing wall **52** and embraces top end **52***a* of the wall. This prevents contact portion **54** from moving outwardly away from the wall. Each terminal includes a mounting leg **64** disposed within a channel **66** in housing **12** to anchor fixed end **56** of the contact portion. It is contemplated that housing **12** can be unitarily molded of dielectric material such as plastic or the like, and the housing can be overmolded about mounting legs **64** of the terminals to anchor the terminals in the housing. Finally, the inner ends of mounting legs **64** are bent downwardly to form terminal tails **68** for insertion into appropriate holes in the printed circuit board and for connection, as by soldering, to circuit traces on the board and/or in the holes. It can be seen in FIGS. **5** and **6** that the terminal tails of alternating terminals are offset to define two rows of terminal tails longitudinally of the connector.

Finally, wall **52** of housing **12** is provided with a projection **70** immediately behind contact section **54***a* of contact portion **54** of each terminal. These projections prevent overtravel of the contact portions in flexing toward wall **52**. The wall is tapered, as at **70***a*, on opposite sides of projection **70** to eliminate any abrupt recesses in the front face of the wall and into which the contact portion of the terminal might be forced.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects

as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

We claim:

1. An electrical connector assembly including a pair of hermaphroditic connectors having opposed mating faces which are juxtaposed generally along a plane when the connectors are mated, with the connectors being adapted for mating in either opposite direction generally parallel to said plane of the mating faces, each hermaphroditic connector comprising:

a plastic housing including a wall at the mating face of the connector, the wall extending in said mating direction and including an edge at opposite ends; and

at least one terminal mounted on the housing and having a contact portion spaced outwardly of said wall for flexing toward and away from the wall generally perpendicular to said mating direction, the contact portion having a first end anchored with overmolded plastic at one end of the wall and a second end having a hook engageable with the opposite end of the wall embracing the edge, and slidable relative thereto in said mating direction.

2. The electrical connector assembly of claim **1** wherein said wall includes a projection behind the contact portion of the terminal intermediate said first and second ends thereof to prevent overtravel of the contact portion in flexing toward the wall.

3. The electrical connector assembly of claim **2** wherein said wall is tapered on opposite sides of said projection.

4. The electrical connector assembly of claim **1** wherein said contact portion of the terminal is bowed outwardly of said wall at a point intermediate the first and second ends of the contact portion.

5. The electrical connector assembly of claim **4** wherein said wall includes a projection behind the contact portion of the terminal intermediate said first and second ends thereof to prevent overtravel of the contact portion in flexing toward the wall.

6. The electrical connector assembly of claim **1**, including a plurality of said terminals spaced along the housing at the mating face of the connector.

7. An electrical connector assembly including a pair of hermaphroditic connectors having opposed mating faces which are juxtaposed generally along a plane when the connectors are mated, with the connectors being adapted for mating in either opposite direction generally parallel to said plane of the mating faces, each hermaphroditic connector comprising:

a plastic housing including a wall at the mating face of the connector, the wall extending in said mating direction and including opposite ends and an edge; and

a plurality of terminals mounted on the housing and spaced along the mating face of the connector, each terminal including a contact portion bowed outwardly of said wall to be spaced therefrom for flexing toward and away from the wall generally perpendicular to said mating direction, the contact portion having a first end anchored at one end of the wall with overmolded plastic and a second end engageable with the opposite end of the wall and slidable relative thereto in said mating direction, and the second end of the contact portion having a hook for embracing said edge of the wall.

8. The electrical connector assembly of claim **7** wherein said wall includes a projection behind the contact portion of the terminal intermediate said first and second ends thereof to prevent overtravel of the contact portion in flexing toward the wall.

9. The electrical connector assembly of claim **8** wherein said wall is tapered on opposite sides of said projection.

10. An electrical connector having a mating face along a plane when the connector is mated with a complementary connector, comprising:

a plastic housing including a wall at the mating face of the connector, the wall extending generally parallel to said plane and including an edge at opposite ends; and

at least one terminal mounted on the housing and having a contact portion spaced outwardly of said wall for flexing toward and away from the wall generally perpendicular to said mating face, the contact portion having a first end anchored at one end of the wall with overmolded plastic and a second end having a hook engageable with the opposite end of the wall, embracing the edge, and slidable relative thereto generally parallel to the mating face.

11. The electrical connector of claim **10** wherein said wall includes a projection behind the contact portion of the terminal intermediate said first and second ends thereof to prevent overtravel of the contact portion in flexing toward the wall.

12. The electrical connector of claim **11** wherein said wall is tapered on opposite sides of said projection.

13. The electrical connector of claim **10** wherein said contact portion of the terminal is bowed outwardly of said wall at a point intermediate the first and second ends of the contact portion.

14. The electrical connector of claim **13** wherein said wall includes a projection behind the contact portion of the terminal intermediate said first and second ends thereof to prevent overtravel of the contact portion in flexing toward the wall.

15. The electrical connector of claim **10**, including a plurality of said terminals spaced along the housing at the mating face of the connector.

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